Gulf Stream - Boundary Interactions

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LONG-TERM GOAL

I seek to understand the influence of the Gulf Stream, as well as other midlatitude jets, on the surrounding ocean. The interrelations between meandering, recirculation and radiation of low frequency energy are of particular interest.

OBJECTIVES

The guiding hypothesis is that the meandering of western boundary currents acts as awavemaker in the ocean. The meanders are quite depth independent and force mainly barotropic motions exterior to them. These motions propagate as low frequency Rossby waves and those to the north of the stream eventually become topographic Rossby waves as they begin to feel the bottom topography. Based on theoretical and numerical modeling of the Gulf Stream region, two areas of enhanced coupling are predicted: near Cape Hatteras and to the west of the Grand Banks. We wish to discover whether or not this process is observed in the ocean. It is possible that similar dynamics are at work near the Polar Front in theJapan/East Sea.

APPROACH

An array of current meters was deployed in late summer of 1995 on the Continental Rise tothe west of the Grand Banks (near 53W) to record low frequency motions for a two year period. The array was composed of 2 lines of current meter moorings, one of which was coincident with a track of the Topex/Poseidon altimetric satellite. The equipment was recovered successfully in September 1997 and the resulting data has been compared with the climatological data base for the region, as well as the altimetric information, to discover whether or not this is a region of enhanced low frequency energy. In support of the ONR supported Japan/East Sea another mooring was maintained in the Japan/East Sea for two years. Analysis, in cooperation with Korean scientists, will begin soon.

WORK COMPLETED

The majority of the instruments above 1000m depth that were recovered from the GrandBanks array suffered from degradation by biological growth on the rotors and vanes. We have developed a method, based on the assumption that high frequency energy should remain more or less constant, to correct for

the obvious reduction in speeds in the records. We have then analyzed the records for evidence of topographic Rossby waves and coupling with the Gulf Stream.

RESULTS

Eddy kinetic energy is, indeed, found to be higher than elsewhere in the region but only atperiods shorter than about 10 days. At longer periods energy in near bottom motions is mainly a function of water depth and, surprisingly, is more or less independent of geographic position. The mechanism for enhancement of the higher frequency variability is unclear but it does not appear to be related to the hypothesized coupling with eastward-travelling meanders. Instead, it is more likely to be associated with forcing by transient motions of the Gulf Stream, which is able to excite a broadband response. This work has been submitted for publication (Hogg, submitted).

The continuing collaboration with Steve Jayne, a former graduate student in the WHOI/MIT Joint Program (and now at NCAR), on the production of recirculations by instabilities of a meandering jet has resulted in a manuscript which is now in press (Jayne and Hogg, 1999). We expect to continue this work to include true multi-layer physics.

IMPACT/APPLICATION

We anticipate that the work with the current meter data set will give a better understanding ofthe origins of the energetic low frequency motion field that is observed on the Continental Slope and Rise. These motions are a dominant part of the total energy in these regions.

Although our fieldwork in the Japan/East Sea has ended we expect that our single mooringwill provide important information to modelers. It is the only such mooring, south of the Polar Front and north of the Tsushima Strait, of which we are aware.

REFERENCES

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PUBLICATIONS

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